If we take the value of K on cooling in air with a rate < 1 m/sec of $0.0046 \cdot 10^4$ W/m^2·K and when cooling is done in water as $0.4187 \cdot 10^4$ W/m^2·K [3], the ratio $K_{wat}/K_{air} = 90$ and corresponds closely to the ratio for heat changes in air and water cooling of 65-70.

The sharp differentiation in the thermal-shock resistance of the fragmented brick when cooling in air and in water agrees with the data from a large number of tests carried out at the Eastern Institute of Refractories on some non-thermal-shock resistance articles. The tests on dense corundum refractories established that the thermal-shock resistance of specimens of a normal size when cooled in air or water are roughly the same and comparatively low; the thermal-shock resistance of small laboratory specimens is significantly higher when cooling is done in air.

An increase in the thermal-shock resistance of a fragmented brick with air cooling, as follows from the above comparison, is produced by the shape factor. Moreover, the shape factor affects the thermal-shock resistance in different ways depending on the Bio criterion: in water cooling it has almost no effect but in air cooling the effect is significant.

The framentation on one surface of the magnesite brick increases the thermal-shock resistance, in particular in those cases where, on one side of the article the operational temperature is roughly constant and on the other, fragmented, surface it is variable. Such conditions exist in some heating furnaces, e.g., in coke furnaces.

The MU-89 magnesite articles fragmented on one surface were tested in the dividing wall of an experimental coke furnace and showed significantly greater thermal-shock resistance than the unfragmented refractories.

The optimal size of the fragment and the depth of the saw cuts must obviously be chosen by trial and error depending on the operational conditions and the thickness of the articles in the direction of the temperature gradient.

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EFFECT OF THE STORAGE TIME ON THE PROPERTIES OF PLASTIC CHROMITE ALUMINA MASSES

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When the plastic chromite—alumina mass (TU 14-8-280-78) is used [1], it becomes necessary to check its physicoceramic properties as a function of various storage times. We have studied specimens from freshly prepared mass and also from masses after storage for 1 and 3 months after preliminary wetting in concrete mixers. The specimens, diameter and height 50 mm, were pressed at 25 MPa, dried at 100°C, and fired at 800, 1000, and 1300°C.

The values of the properties of the specimens, determined using the standard methods, are given in Table 1.

When the storage time of the mass and the heat firing temperature are increased, the strength and apparent density increase while the thermal-expansion coefficient decreases.

It was established in the studies carried out in [2] that the dynamic elastic modulus of the mass changes from 2 to 28 MPa up to 800°C. The temperature dependence of the change in E_{dyn} of the plastic masses with

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TABLE 1. Properties of Specimens as a Function of the Storage Time and the Heat-Treatment Temperature

Properties	Heat treatment, °C	Value of property of specimen from mass		
		freshly prepared	after storage	
			1 month	3 months
Ultimate compressive strength,* MPa	100	$\frac{4,8-7,8}{6,6}$	$\frac{4,3-5,6}{4,8}$	$\frac{5,2-6,6}{5,8}$
	800	$\frac{10,05-16,84}{12,8}$	$\frac{12,3-12,4}{12,3}$	$\frac{13,0-17,6}{14,9}$
	1200	$\frac{12,2-19,6}{15,7}$	$\frac{12,9-17,3}{15,0}$	$\frac{34,2-38,5}{35,8}$
	1300	$\frac{30,7-37,9}{35,2}$	$\frac{44,0-48,9}{46,5}$	$\frac{54,0-61,7}{56,8}$
Open porosity,* %	100	$\frac{18,4-18,7}{18,6}$	$\frac{17,7-18,6}{18,3}$	$\frac{18,7-19,6}{19,2}$
	800	$\frac{24,1-26,9}{25,1}$	$\frac{24,9-26,2}{25,4}$	$\frac{24,4-25,1}{24,7}$
	1200	$\frac{21,3-22,6}{21,8}$	$\frac{22,5-23,4}{23,1}$	$\frac{21,6-22,5}{22,1}$
	1300	$\frac{22,6-24,6}{23,4}$	$\frac{22,7-24,7}{23,7}$	$\frac{21,8-23,0}{22,2}$
Apparent density,* g/cm^3	100	$\frac{2,99-3,04}{3,01}$	$\frac{2,94-2,98}{2,96}$	$\frac{2,97-2,97}{2,97}$
	800	$\frac{2,76-2,85}{2,80}$	$\frac{2,69-2,79}{2,96}$	$\frac{2,86-2,89}{2,87}$
	1200	$\frac{2,86-2,89}{2,87}$	$\frac{2,79-2,84}{2,82}$	$\frac{2,84-2,87}{2,86}$
	1300	$\frac{2,85-2,95}{2,89}$	$\frac{2,78-2,84}{2,81}$	$\frac{2,88-2,94}{2,91}$
Temp. of commencement of deformation under a load of 0.2 MPa, °C	800	1240	Not det'd	1280
	1200	1200	1210	1250
	1300	1230	1210	1260
Linear thermal-expansion coefficient in the 200-1350°C interval, $\alpha \cdot 10^6$, °C^{-1}	100	1,55	1,41	1,11

* Numerator gives extreme values; the denominator, the average values.

various storage times is shown in Fig. 1. It is clear that there is only a very slight strengthening of the concrete in the 600-800°C interval as a result of the dehydration of the clay at 580°C. When the temperature is further raised to 1100°C, the dynamic elastic modulus increases very slightly as a result of the compaction of the concrete after the formation of the complex spinel (Mg, Fe)OAl$_2$O$_3$.

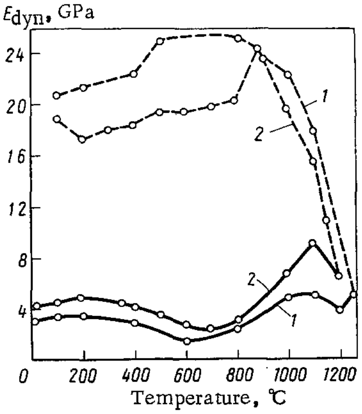

Fig. 1. Change in the dynamic elastic modulus E_{dyn} of a freshly prepared mass (1) and a mass after 3-month storage (2) on heating (——) and cooling (---).

At 1100-1200°C, E_{dyn} is reduced because of the emergence of a liquid phase in the concrete. The sharp increase in E_{dyn} on cooling from 1200 to 800°C may be explained by the increased rigidity of the structure associated with the crystallization of the liquid phase.

At a temperature below 800°C, E_{dyn} of the concrete made from a freshly prepared mass is reduced clearly because of the formation of microcracks; E_{dyn} of the concrete made from a mass is reduced only very slightly after a 3-month storage.

It has been established that there is a reduction in the concentration of P_2O_5 from 1% in the freshly prepared mass to 0.63% in the mass after a storage of 3 months.

CONCLUSIONS

The properties of freshly prepared chromite alumina plastic mass and masses after storage for 1 and 3 months have been determined. It is established that the mass after a 3-month storage has better ultimate compressive strength, thermal-expansion coefficient, apparent density, and dynamic elastic modulus.

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PRODUCTION OF BONDING-AGENT SUSPENSIONS AND CERAMIC CONCRETE BASED ON DINAS

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Ceramic refractory concretes are of particular interest [1] in the field of the production and application of concretes and are based on coarse ceramic filler in which the cavities between the grains are filled with a finely dispersed ceramic bonding phase followed by the formation of a strong conglomerate. In many cases it is advantageous to have silaceous concretes [2] and therefore it seems reasonable to develop ceramic concretes analogous (in relation to the filler) to compositions using binder suspensions of silica which would have obvious advantages over the normally used bonding agents based on water glass, phosphates, or alumina cement.

It has previously been shown in [1, 3, 4] that it is possible to obtain binder suspensions made of vitreous silica and quartz sand and also to produce ceramic concretes based on these materials. However, the materials with the bonding agent made from vitreous silica suspensions are expensive and scarce and those based on quartz sand are not thermal-shock resistant and, what is particularly important in the case of refractory concretes, they are not sufficiently volume-constant because of the phase transformations of quartz [5, 6].

Therefore, we have set ourselves the task of obtaining binder suspensions made of dinas (i. e., a material in which the modification transformations have to a significant extent already been completed) and also from the ceramic concrete based on these suspensions and a filler made from dinas cullet (5-10 mm). As the starting material for these suspensions and for the filler, we used the cullet from dinas articles used to line glass-melting furnaces (GOST 3910-75) with an open porosity of 22%. In this initial material the concentration of SiO_2 was 93.3%,* CaO 2.5%, Fe_2O_3 1%, and Al_2O_3 1.9%. After milling with corundum milling bodies, the concentration of Al_2O_3 increased and reached 3.0% in the suspension.

In order to achieve adequate binding properties in the dinas suspensions, we obtained them using the production method and under the conditions previously developed for other ceramic suspensions [3, 6, 7]. The wet milling of the suspensions was done in a ball mill of 170-liter capacity with a quartz lining and corundum

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* Here and elsewhere, mass fractions are given.

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